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NATIONAL WEATHER SERVICE INSTRUCTION 30-4102
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Maintenance, Logistics and Facilities
***Facilities Management NWSPD* 30-41**

FACILITIES DESIGN

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Signed by 12/18/2002
John McNulty, Jr. Date
Director, Office of Operational Systems

Facilities Design

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1. Introduction. This instruction implements NWSPD 30-41, Facilities Management. In the early 1980s, the National Oceanic and Atmospheric Administration (NOAA) launched a major program to modernize the National Weather Service (NWS) based on new technology and knowledge in the sciences of meteorology and hydrology. Inherent in this process was phasing the existing field organization into a streamlined network of Weather Forecast Offices (WFOs) strategically located across the United States. Experience gained from the process of design is summarized in this instruction. These processes include development of design documents to achieve low life cycle cost (LCC) for future facilities.

2. Purpose. The purpose of this document is to provide design instruction to implement NWSPD 30-41, Facilities Management. In addition, guidance provided in NOAA Administrative Order (NAO) 217-104, *Project Development, Approval, and Management (PDAM) Process* is used for development, approval, and management of construction projects.

3. Scope. This document covers the design phases in the PDAM process. This instruction provides guidance for NWS Headquarters, Regional Headquarters and National Centers.

4. Project Management.

4.1 The Project Manager. The project manager is responsible for scope, requirements definition, project approval, budgeting and schedules. The project manager monitors and coordinates the individual project activities with the team.

4.2 Project Team Composition. The project team consists of NWS Headquarters, the NWS Region where the project is located, an assortment of Administrative Support Centers (ASC), as well as engineering, architecture, environmental and real estate support contractors.

4.3 Administrative Support Center. Under the Department of Commerce (DOC), the ASCs provide consistently high-quality administrative, technical, and logistical support services to DOC customers, on time and at minimum cost, enabling them to fulfill their missions and goals. These ASCs provide their services to other DOC agencies, including NWS, on a "fee for service" basis.

Although ASCs are typically made up of five divisions, the following three often interact with the NWS during the design process:

4.3.1 Acquisition Management Division. This division acquires property and non-personal services (including information technology, construction, and utilities) through purchasing, leasing, interagency agreements, and contracting. This includes requisitioning from other Government sources and the use of simplified acquisition procedures (acquisitions of $100,000 or less) as well as formal contracting procedures. The Division also performs contract administration services to ensure compliance with the provisions of awarded contracts as a part of its overall procurement service to its clients.

4.3.2 The Facilities and Logistics Division. This division administers real and personal property programs for all DOC field offices. They also arrange for the shipment of property, equipment, and household goods; coordinate printing and publication services; and provide engineering and design support. In addition, they ensure the implementation of DOC occupational safety and health programs as well as the environmental compliance program of NOAA.

4.3.3 The Finance Division. This division provides a wide variety of financial management support services including administrative payments, analysis of financial data, budget formulation and execution, and accounting support.

4.4 Architect and Engineering (A/E) Selection. The A/E Contractor shall be required to furnish all design services including but not limited to: architectural, site planning, civil, structural, mechanical, electrical, fire protection engineering; interior and laboratory design; furniture, fittings, and equipment identification and selection; and telecommunications /information systems associated with the building design, site development, utility layout, and facility management systems, as well as development of construction documents. Other related services that may be required to be performed under this contract include Bid Phase, Construction Phase, and Occupancy Phase services. A/E firms are selected based on the following criteria: past performance, experience of key personnel, capacity of firm (and subcontractors) to accomplish the work, specialized experience, project manager's experience, experience in sustainable design, and ability to communicate with the Government.

4.5 Other Consultants. Should the need arise, other contractors may be engaged at the discretion of the Project Manager subject to approval by the Project Manager’s Branch Chief. Depending on the nature and complexity of a project, other specialized consultants may be needed for laboratory programming, laboratory design, cost estimating, and communications.

5. Building Codes and Standards. Since there is a strong possibility that the codes and standards will change, it is the A/E Contractor's responsibility to ensure that the provisions and requirements of the latest adopted version/edition of each code are incorporated into the final design document submittals. If there are any questions regarding the implementation of applicable codes and standards, it is the A/E Contractor's responsibility to notify the Contracting Officer's Technical Representative (COTR) or its delegated agent for direction on how to proceed.

5.1 Local Authorities. Although NWS, as a federal agency, does not have to comply with local codes, NWS realizes that its facilities are dependent on utilities and services provided by local agencies such as fire protection services. Hence, NWS intends to comply with local codes and regulations to the maximum extent possible.

5.2 Accessibility Compliance. The design shall comply with the Uniform Federal Accessibility Standards (UFAS) and the Americans with Disabilities Act Accessibility Guidelines (ADAAG).

5.3 Energy Analysis and Design. Energy-saving projects must pay off in the long run. The Federal Energy Management Program (FEMP) recommends LCC analysis, evaluates the cost-effectiveness of energy and water conservation, and is promulgated in 10 CFR 436, *Life Cycle Cost Methodology and Procedures,* which conforms to provisions in the Federal Energy Management Improvement Act of 1988 and subsequent energy conservation legislation. In addition, LCC fulfills the requirements of Executive Order 13123, *Greening the Government through Efficient Energy Management*.

5.4 National Environmental Policy Act (NEPA) and Historic Preservation. The NEPA contractor shall perform the following tasks:

5.4.1 Data Collection and Initial Agency Consultations. The NEPA contractor will participate in meetings with NWS to assemble data on the planned facility. The NEPA contractor will collect necessary and relevant information (e.g., floor space, a construction schedule, number of employees, activities to be housed) on the proposed facility from the NWS. That information will be assembled into a statement of purpose and need and a general (not site-specific) description of the proposed action for use in the environmental assessment (EA). Information on environmental conditions (e.g., sensitive environmental resources, soil and hydrologic conditions, flood hazards, habitats for protected species, historic resources, road access, zoning) at the proposed location of the facility and its vicinity will also be assembled. Data on other proposed development in the area will be included. The NEPA contractor will conduct a field reconnaissance of the proposed location to obtain information. The NEPA contractor will also consult with local, state, and federal planning, environmental, and natural-resource agencies to identify their concerns and obtain background data.

5.4.2 Preliminary Draft Environmental Assessment (EA). The NEPA contractor will prepare and submit to NWS 10 copies of a preliminary draft EA analyzing the proposed action and the no-action alternative. The EA will comply with Council on Environmental Quality guidelines for implementing NEPA (40 CFR 1500-1508) and NAO 216-6. The full range of possible

environmental impacts will be analyzed and feasible measures to reduce identified impacts to insignificant levels will be identified where necessary or desirable. Both individual impacts, from the implementation of the following alternative actions, and cumulative impacts, from implementation of any of those actions and other proposed development in the vicinity, will be analyzed for the various design alternatives.

The significance of each impact will be determined by covering the following issues: Air quality; drainage and water quality; energy consumption; environmental justice; farmland; flood plains; flora and fauna (threatened and endangered species); geology, soils, and mineral resources; historic and cultural resources; land-use compatibility and zoning; noise (construction and operation); socioeconomics; transportation; visual quality; wetlands; and wild and scenic rivers/wilderness areas.

Special studies may be required in the areas of flora and fauna (e.g., endangered species surveys) and historic resources (archaeological survey). The NEPA contractor will be responsible for managing preparation of those studies, including selection and oversight of qualified subcontractors as needed.

An Environmental Due Diligence Assessment (EDDA) examines the potential for NWS to incur liability for environmental contamination at the property to be leased. This is set forth in requirements in Chapter 2 of the DOC Real Property Management Manual and American Society of Testing and Materials (ASTM) Standard E1527-97, *Standard Practice for Environmental site Assessments: Phase 1 Environmental Site Assessment Process*. Both preparation of an EDDA, and sampling or testing of media should be included in the estimated cost. The EA will identify potential risks that may arise from exposure of construction workers or NWS personnel to contaminated natural media or hazardous building materials at the various site alternatives.

5.4.3 Draft EA. The NEPA contractor will revise the Preliminary Draft EA as necessary in response to comments from the NWS. Upon receiving NWS approval, the NEPA contractor will publish and distribute to interested members of the public and government agencies up to fifty (50) copies of the draft EA. Comments on the draft EA will be accepted from the public for 30 days.

5.4.4 Preliminary Final EA. The NEPA contractor will collect and organize comments on the draft EA received from the public and government agencies. Responses to those comments will be prepared and incorporated into the EA and the document will be revised as necessary to respond to those comments. Ten copies of a Preliminary Final EA will be printed and submitted to NWS for review and comment.

5.4.5 Final EA. The NEPA contractor will revise the Preliminary Final EA as necessary in response to comments from the NWS. Upon receiving NWS approval, the NEPA contractor will publish and distribute to interested members of the public and government agencies up to 50 copies of the Final EA.

5.4.6 Finding of No Significant Impact (FONSI) and Decision Support. The NEPA contractor will prepare and submit to NWS in electronic form a draft FONSI as appropriate. The draft

FONSI will comply with requirements set forth in NAO 216-6. The NEPA contractor will assist NWS in distributing the FONSI and reply to questions or comments from the public concerning the NWS decision in this matter.

5.5 Sustainable Design/Leadership in Energy and Environmental Design (LEED). Sustainable, or "green" building design embraces a "whole building" approach, in which the interdependence of building elements and systems are exploited to make it as energy efficient as possible. Sustainable design recognizes the impact of every design choice (window placement and type of cooling system, for example) on the natural and cultural resources of the local, regional, and global environment. Sustainable design principles developed by Department of Energy (DOE), General Services Administration (GSA), and Department of Defense (DOD) will be incorporated into the requirements for all new construction and major renovation projects.

To measure the sustainability or "green-ness" of a building, an industry standard performance-oriented system has been developed called Leadership in Energy and Environmental Design (LEED). Different levels of green building certification are awarded based on total credits earned.

To comply with the intent of Executive Order 13123, *Greening the Government Through Efficient Energy Management*, each major building or renovation project shall be LEED registered and strive for a minimum LEED certification of a silver rating. See http://www.leedbuilding.org.

5.6 Lightning Protection. The design and installation of lightning protection systems apply to new and existing facilities. The guidelines to be followed are National Fire Protection Association (NFPA) 70, *National Electrical Code* and NFPA 780, *Standard for the Installation of Lightning Protection Systems*. NWS facilities guidelines for the design and installation of lightning protection systems are shown in NWSM 30-4116 "Lightning Protection, Grounding, Bonding, Shielding, and Surge Protection Requirements." All new facilities will comply with this manual.

6. A/E Design Services/Deliverables.

6.1 Drawings/Computer-Aided-Design (CAD) Standards. The A/E Contractor shall develop all electronic drawings in a format that can be used directly (without conversion) by AutoCAD Release 2000 for Windows, or later versions. In addition, the A/E Contractor shall ensure that the drawing files include all custom fonts or menus used to modify the drawings, and more importantly, all external references (XREF) are bound as opposed to attached. Drawing representations need only be in two dimensions, although three dimensional imaging is acceptable. In addition, the A/E Contractor shall ensure that the layering is in accordance with the CAD Layer Guidelines, Second Edition (1997) by the American Institute of Architects. Drawings shall be complete in detailing floor plan views, exterior elevations, building sections, system distributions, riser diagrams, and equipment description schedules.

Each final working drawing and each submitted specification and calculation document shall be signed by, bear the seal of, and show the state certificate number of all architects and engineers who prepared the document or are responsible for its preparation.

6.2 Specifications. The A/E Contractor shall provide preliminary working drawings and a draft of the final construction specifications using the Construction Specifications Institute (CSI) format and/or brand name references with sample catalog cuts and manufacturer's literature as required to identify components, materials, performance and operating characteristics. The A/E Contractor shall also submit final calculations for selection and sizing of all building features, systems, and equipment.

6.3 Cost Estimate/LCC. The A/E Contractor shall submit a preliminary Current Cost Estimate that consists of the Estimate of Construction Costs and the Estimate of Project Costs. The cost estimates must be based on a building systems approach using an itemized list of system components.

The Estimate of Construction Costs is based on the construction costs at the midpoint of the construction period and includes the following items, as a minimum: building costs (using CSI format); on-site development costs; off-site development costs; environmental protection costs; interior build-out costs; equipment costs (e.g., built-in freezers, laboratory benches, fume hoods); permits, fees, bonds, and taxes; and construction contractors' overhead and profit.

The Estimate of Project Costs includes the following items, as a minimum: furniture, fixtures, and equipment costs; moving and relocation expenses; land acquisition costs; consultant fees; construction management and inspection fees; operations and maintenance training costs; contingencies; and other costs.

All contingencies and Construction Contractors' overhead and profit expenses must be clearly defined with a brief justification statement.

LCC analysis should look at the initial investment and total cost of owning/leasing a facility. LCC factors include initial investment, inflation (discount factor), time value of money, operating costs and maintenance costs.

7. Fees and Fee Negotiation.

7.1 Rule of Thumb. Generally, the A/E fee for normal projects that are not particularly complex is about 10 percent of the construction cost for projects that are between $0.5K and $5.0 million in construction cost. The higher the construction cost, the lower the percentage fee, and vice versa. Complex projects such as laboratories may require a higher fees (12 percent to 15 percent) since they require more man-hours to design.

7.2 Six Percent Fee Limit. The government imposes 6 percent limit on the (pure) design fee. Such limitation does not include A/E services outside design, such as feasibility studies, programming, conceptual studies, geo-technical investigation, topographical survey, environmental surveys, and A/E support during construction. The A/E fee has to be 6 percent of construction cost for pure design (30 percent, 60 percent, 90 percent and 100 percent submissions).

7.3 Design Modifications. Modifications can be incorporated at any stage in the project. However, the more advanced the design, the higher the modification cost. Hence, it is best to conduct thorough programming and schematic design phases to avoid any modifications during the design development phase (60 percent) and the construction document phase (90 percent and 100 percent). Modifications during construction are the most expensive and they should be avoided, if possible. Design modifications will have to be negotiated with the A/E firm through ASC in order to arrive at a mutually acceptable fee. If a modification is executed during construction, the A/E firm will prepare a cost estimate for the modification. The government will use it as the basis for negotiation with the contractor. The contractor will be required to submit a modification (change order) cost broken down by the 16 divisions of the specifications. Modifications are common in every project so the project manager should anticipate them and budget at least 10 percent of the construction budget as a "contingency" modifications. The project manager should expect a higher level of modifications in renovation projects due to unforeseen conditions.

8. Design Submittals.

8.1 Thirty Percent Design. This phase is referred to as the conceptual design or schematic design. The submission should demonstrate compliance with the relevant codes and zoning, the space program identified in the programming phase, functional requirements, adjacencies, and the massing should respect the context for the project. Engineering systems must be defined in a narrative form in this phase. Building envelope should be defined and should respect and relate to the context of the project. The A/E should consider at least three conceptual options and recommend one. A design narrative should be included describing the design approach and the rationale for it. The cost estimate should be consistent with the programming phase and be included in the report.

8.2 Sixty Percent Design. This phase is also referred to as the design development phase. Engineering systems must be defined in this phase and incorporated into the architecture. This includes civil, structural, heating, ventilation and air conditioning (HVAC), plumbing, electrical, fire protection, and security. All building elements and components must be selected, defined, and incorporated in this phase of the work. This includes building envelope, interior construction, service spaces, and elevators. Outline specifications should be produced and included in this package.

8.3 Ninety Percent Design. This is the construction document phase. This phase includes the production of working drawings that identify all the necessary details. Engineering disciplines should be well-coordinated and incorporated into the architecture. The drawings should also be consistent with the specifications. The notes on these drawings should result in a single interpretation of a specific set of data and become the basis of a competitive price proposal.

8.4 One Hundred Percent Design. This is the refinement and completion of the previous phase, especially in the area of specifications.

8.5 On-Board Review. In certain cases, and when the government wants to accelerate a schedule, it might opt to review the 30 percent or the 60 percent submission in the A/E offices on the boards to save time and the cost of reproduction.

9. A/E Design Disciplines. The following is a brief description of the design philosophy for each A/E discipline that should be adopted by the design firm. Most of the information is extracted from the design manual, GSA PBS-P100, November 2000.

9.1 Civil. Civil engineering design should balance cut and fill when the facility is placed on a contoured site. The civil engineer will coordinate the utilities connection points and routings with the utility providers. Utility elements should be located in a way that will provide easy access. They should be integrated into the landscape design without creating a negative visual image.

9.2 Landscape Architecture. The quality of the site design will be a direct extension and integration of the building design intent. It represents significant Federal investment and should, wherever possible, make a positive contribution to the surrounding urban, suburban or rural landscape in terms of conservation, community design and improvement efforts, local economic development and planning, and environmentally responsible practices.

The use of site design to aid energy conservation and sustainability is encouraged. Solar orientation of the building and well placed plant material can be used to increase heat gain in the winter and reduce heat gain during the summer.

Sustainable design benefits GSA with healthier, longer lived plantings that rely less on pesticides, herbicides and fertilizers, minimize water use, require less maintenance and increase erosion control (GSA PBS-P100, November 2000).

9.3 Architecture. Landscape, architectural and interior design must be integrated with all project design disciplines in order to optimize building performance and aesthetics. Prior to initiating any schematic design, the architect must perform a series of coordination meetings with all project design disciplines/consultants to explore performance and functional objectives that could impact building orientation, massing, space adjacencies, material selections, and assemblies.

9.4 Interior Design. General office space (open and enclosed offices) comprises a large proportion of area in NWS buildings. Materials, surfaces, and systems must be chosen with quality and flexibility as primary concerns. Office spaces characteristically change with their occupants, occupancy configurations, and utility requirements. Interior finishes should allow these transformations to occur with minimal disturbance and cost (GSA PBS-P100, November 2000).

9.5 Structural. The structural design for a facility should respect the architectural concept and be consistent with it. It should also work with the construction technology available in the area. The structural designer should be aware of the region where the facility is to be located and the available construction technology. The design should also consider local environmental issues

such as hurricanes in the Southern Region, extreme cold temperature in Alaska, and earthquakes in the Western Region.

Environmental Protection Agency (EPA) Comprehensive Procurement Guidelines indicate the materials that must contain recycled content in the construction of buildings with federally appropriated funds (GSA PBS-P100, November 2000). An example is the use of fly ash in concrete mix.

9.6 Mechanical/HVAC. The design of an NWS facility's air conditioning system needs to take into consideration energy efficiency, maintainability, and cost effectiveness. Executive Order 13123 and FAR section 23.704 direct government agencies to purchase products in the upper 25 percent of energy efficiency, including all models that qualify for the EPA/DOE ENERGY STAR® product labeling program. It is the NWS's intent to fully comply with this requirement. This will result in substantial operating cost savings, while minimizing pollution.

LEED guidelines as they apply to mechanical system design will also be included in the design of WFOs. This would entail a mechanical system commissioning, minimum indoor air quality performance, carbon dioxide monitoring, increased ventilation effectiveness, and compliance with the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 55-1992, Thermal Comfort.

Energy efficiency can be improved by taking into consideration local conditions whenever possible. For example, an economizer mode should be included to take advantage of free cooling. Geothermal heat pumps should be used whenever possible to reduce energy costs. Architects should be consulted so new buildings can be positioned to take advantage of natural shade, and operable windows positioned to take advantage of natural breezes. Variable air volume systems will be standard so the proper amount of air will be delivered to building occupants and equipment. Where local atmospheric conditions dictate the installation of a humidification system, a console type ultrasonic humidifier will be used. Proper humidification levels will increase occupant comfort and prevent electrostatic discharge, which can damage electronic equipment.

Direct digital controls will be native building automation and control network (BACnet) systems compliant with American National Standards Institute (ANSI)/ASHRAE Standard 135-1995 to allow for greater flexibility for future system modifications. The controls system will run on Java-based software for added network security and will be accessible through any standard web browser, providing building zone temperatures, equipment control, and system alarms. The controls system will use an algorithm developed by the NWS to control the discharge air temperature, variable-volume (VAV) boxes, and electric duct heaters based on a comparison of building zone temperatures to provide tighter temperature control. The HVAC system will be connected to the facility's emergency power system. Air handling units, condensing units and computer room air conditioning units will be redundant; a back-up unit will automatically be started in the event of an equipment failure. These measures will minimize disruption to mission critical work and provide a comfortable working environment for the building's occupants.

Each building will also have a redundant stand-alone computer room air conditioning system

providing conditioned air to the space through the computer room flooring. The air conditioning units will be sized to maintain a constant 72 to 77 degree temperature and provide an adequate humidity level to avoid electrostatic discharge in the computer room. Computer room temperature set points less than 72 degrees result in wasted energy and, unless specifically recommended by an equipment manufacturer, should be avoided at all times.

9.7 Electrical.

9.7.1 Emergency Power Systems.

a. The emergency power system must be designed in accordance with NFPA 110, Emergency and Standby Power Systems.
b. Generators should be located at least 30 m (100 feet) from communications frame equipment to avoid radio frequency interference.
c. The distribution system should be designed so emergency and auxiliary power sources cannot backfeed energy into the de-energized normal voltage systems under normal, emergency or failure conditions.
d. Automatic transfer switches serving motor loads should have in-phase monitor (transfer when normal and emergency voltages are in phase) to reduce possible motor damage caused by out-of-phase transfer.
e. In order to reduce possible nuisance tripping of ground fault relays, automatic transfer switches serving 3-phase, 4-wire loads should have 4-pole contacts with an overlapping neutral.
f. Automatic transfer switches should include a bypass isolation switch that allows manual bypass of the normal or emergency circuits in the event of a switch failure or required maintenance.

9.7.2 Uninterruptible Power Supply (UPS) Systems.

a. When generator back-up is not available, sufficient battery capacity should be provided to allow for an orderly shut-down.
b. An uninterruptible power supply (UPS) system should be sized with 25 percent spare capacity. The UPS system should serve critical loads only. The nature, size, and locations of critical loads to be supplied by the UPS will be provided in the program.
c. If the UPS system is backed up by a generator to provide for continuous operation, then the generator must also provide power to all necessary auxiliary equipment, i.e., the lighting, ventilation, and air conditioning supplying the UPS and serving the critical technical area.
d. The system status panel should have an appropriate audio/visual alarm to alert operator of potential problems. It should include the following monitoring and alarm functions: system on, system bypassed, system fault, out-of-phase utility fault, closed generator circuit breaker.
e. Since UPS equipment rooms are usually unattended, additional remote system status panel must be provided in the space served by the UPS.

f. Design the battery room in accordance with Article 480 of National Electrical Code "Storage Batteries". Provide emergency lighting in both spaces.

g. Provide a telephone in or adjacent to the UPS room. Battery room design must include proper ventilation, hydrogen detection, spill containment, and working clearances.

9.8 Fire Protection. Essential electronic facilities consist of spaces that have high value or mission essential electrical equipment such as mainframe computers or telephone switches with the potential for high dollar loss and/or business interruption. Essential electronic facilities shall be designed in accordance with NFPA 75 and the appropriate local code relative to computer room fire alarm system specification (GSA PBS-P100).

9.9 Security. The system requirements shall be based on the Department of Justice Vulnerability Assessment to Federal Facility Report, dated June 28, 1995. The Regional DOC Security Officer shall recommend mitigation measures needed based on the vulnerability assessment conducted.

10. References. The following references contain greater detail:

a. NWS Policy Directive 30-41, Facilities Management.
b. NAO 217-104, Project Development, Approval, and Management Process.
c. The Architect's Handbook for Professional Practice, 13th Edition, 2001.
d. GSA Facilities Standards for the Public Buildings Service (PBS-P100).